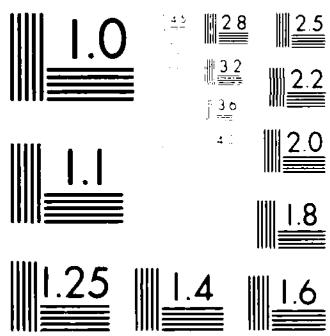
AD-A170 140 NICAD BATTERY PACKAGES(U) NORTHEASTERN UNIV BOSTON MASS ELECTRONICS RESEARCH LAB F J TRACY ET AL. FEB 86 SCIENTIFIC-3 AFGL-TR-86-0052 F19628-81-C-0029 1/1

UNCLASSIFIED F/G 10/3 NL


1.0
2.8
2.5
3.2
2.2
3.6
2.0
1.1
1.8
1.25
1.4
1.6

(12)

AFGL-TR-86-0052

AD-A170 140

NICAD BATTERY PACKAGES

Frederick J. Tracy
Harry M. Tweed, Jr.

NORTHEASTERN UNIVERSITY
360 Huntington Avenue
Boston, Massachusetts 02115

SCIENTIFIC REPORT NO. 3

February 1986

Approved for public release: distribution unlimited.

Prepared for

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

"This technical report has been reviewed and is approved for publication."

Willard F. Thorn

Willard F. Thorn
Contract Manager

Russell G. Steeves

Russell G. Steeves
Branch Chief

FOR THE COMMANDER

C. Nealon Stark

C. Nealon Stark
Division Director

This report has been reviewed by the ESD Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS).

Qualified requestors may obtain additional copies from the Defense Technical Information Center. All others should apply to the National Technical Information Service.

If your address has changed, or if you wish to be removed from the mailing list, or if the addressee is no longer employed by your organization, please notify AFGL/DAA, Hanscom AFB, MA 01731. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document requires that it be returned.

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE A170140

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; Distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFGL-TR-86-0052
6a. NAME OF PERFORMING ORGANIZATION Northeastern University Electronics Research Lab. 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Air Force Geophysics Laboratory
6c. ADDRESS (City, State and ZIP Code) Boston, MA 02115	7b. ADDRESS (City, State and ZIP Code) Hanscom Air Force Base Massachusetts 01731
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F19628-81-C-0029
8c. ADDRESS (City, State and ZIP Code)	10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
62101F	7659	04	BC

11. TITLE (Include Security Classification)
Nicad Battery Packages

12. PERSONAL AUTHOR(S)
Frederick J. Tracy and Harry M. Tweed, Jr.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Scientific Report #3	FROM ____ TO ____	February 1986	16

16. SUPPLEMENTARY NOTATION

17. COSATI CODES		
FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
nickel - cadmium cells
sounding rockets
batteries
ampere hour (AH) rating

19. ABSTRACT (Continue on reverse if necessary and identify by block number)
Presented is the development of a packaging concept for nickel-cadmium (nicad) cells used in sounding rocket payload under Contract F19628-81-C-0029. Included are design specifications, assembly procedures and test sequences four (4) types of nicad batteries.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Willard F. Thorn	22b. TELEPHONE NUMBER (Include Area Code) 22c. OFFICE SYMBOL LCT

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

TABLE OF CONTENTS

ILLUSTRATIONS

1. INTRODUCTION

Problems encountered with purchased battery packages and increasing requirements for larger capacity cells in sounding rocket payloads led to the development of the battery packages in this report. Gell cells, lead acid batteries, silver cells and lithium batteries were considered along with nickel-cadmium (nicad) cells; however, nicads proved to be the most versatile. Several packaging concepts considering ease of assembly and servicing; minimization of weight and volume; and payload environmental requirements were evaluated.

2. CELL TESTING

Test fixtures were fabricated to cycle individual cells in groups of 24 (24 cells at 1.2 volts per cell for a nominal 28.8 volt battery). Two cycles of 14-hour charge at a C/10 rate, followed by a discharge at the 1C rate were used to evaluate the cells. Cells reading 1.0 volt under load after 60 minutes discharge are defined as acceptable and are assigned to battery packs. "C" is numerically equal to the rated ampere hour capacity of the cell. For the standard 1.2AH cell, C = 1.2. "C-rate" is a charge or discharge current (amperes), numerically equal to "C". For example, if C = 1.2, then 2C rate = 2.4 and a 2C discharge would be performed using a 2.4 ampere discharge current. Similarly, a C/10 charge on the same cell implies a 120 milliampere charge current.

Characteristics of the cells included in this report are as follows:

Cell Type	AH Rating	Diameter	Length	Weight
C/2	1.2	1.012 in.	0.925 in.	1.10 oz.
D/2	2.2	1.275 in.	1.448 in.	2.80 oz.
D	4.0	1.275 in.	2.318 in.	4.6 oz.
F	7.0	1.275 in.	3.508 in.	7.4 oz.

3. SEALED BATTERY BOXES

Figure 1 depicts a typical (28.8 volt at 1.2AH) sealed battery box in which the cells are encapsulated in a foam or silastic potting compound. This packaging concept proved suitable for normal operation of 1.2AH and 2.2AH systems; however, thermal problems became a concern if high rate charging or discharging is required. Furthermore, the recent trend to larger payloads with multiple experiments and longer flight times necessitates larger capacity batteries.

4. OPEN FRAME BATTERIES

In contrast to the sealed battery boxes the equivalent open frame unit in Figure 2 requires no potting material and has non-conducting top and bottom trays to hold the cells securely in place. Assembly is simplified since the cells are installed in the trays (observing proper polarity relationships) and can be wired in place. Temporary screws

are used in conjunction with the spacers to clamp the cells in place between the fiberglass trays which are counterbored to hold the cells securely and have 0.25 inch grooves machined to house the interconnecting links below the outside surface of the trays. Figure 3 depicts the top tray for a 1.2AH battery pack which is typical for all assemblies. Details of the counterbore, interconnecting link slots and the through slots for the exit wires are indicated.

Wiring of the sub-assembly, illustrated in Figure 4, is accomplished by soldering all of the interconnecting links on the bottom side, then inverting the sub-assembly to interconnect the top of the cells. Insulators are installed on all interconncting links. The final wiring step is to attach wires to the cells through the top tray to the interface connector. A typical wiring schematic in Figure 4 shows a 28.8 volt battery with a center tap at 14.4 volts, a charging diode, and a monitor resistor. The diode and resistor are typically housed in the connector backshell which is then potted. Other wiring options or connectors can, of course, be specified. At this point the battery is mated to the battery charge/discharge console for evaluation.

The next step in the assembly procedure is to install the jam-nut receptacle (Bendix PT07A-10-6S for standard wiring) on the base mount, remove the temporary screws on the wiring sub-assembly and install the base mount using the seven (7) flathead socket screws indicated in Figure 5. Finally the

cover is installed using seven (7) binder head screws into the stand-offs and four (4) binder head screws into the tapped holes on the base mount. Two cycles of 14-hour charge at the C/10 rate followed by discharge at the 1C rate are then recorded as acceptance tests for each battery pack. When batteries are assigned to a project they are tested to the specific power profile and required environmental specifications.

5. BATTERY TYPES

Three of the nicad cells used (2.2AH, 4.0AH and 7.0AH) have the same diameter and vary only in length, enabling the use of a common top tray, bottom tray and cover. Selecting the proper stand-off and base mount allows fabrication of any of the three batteries. Assembly Drawing #D-5061 (Figure 5) is tabulated to enable selection of the required hardware. A second assembly drawing (Figure 6) is dedicated tothe 1.2AH batteries since the cell diameter is smaller.

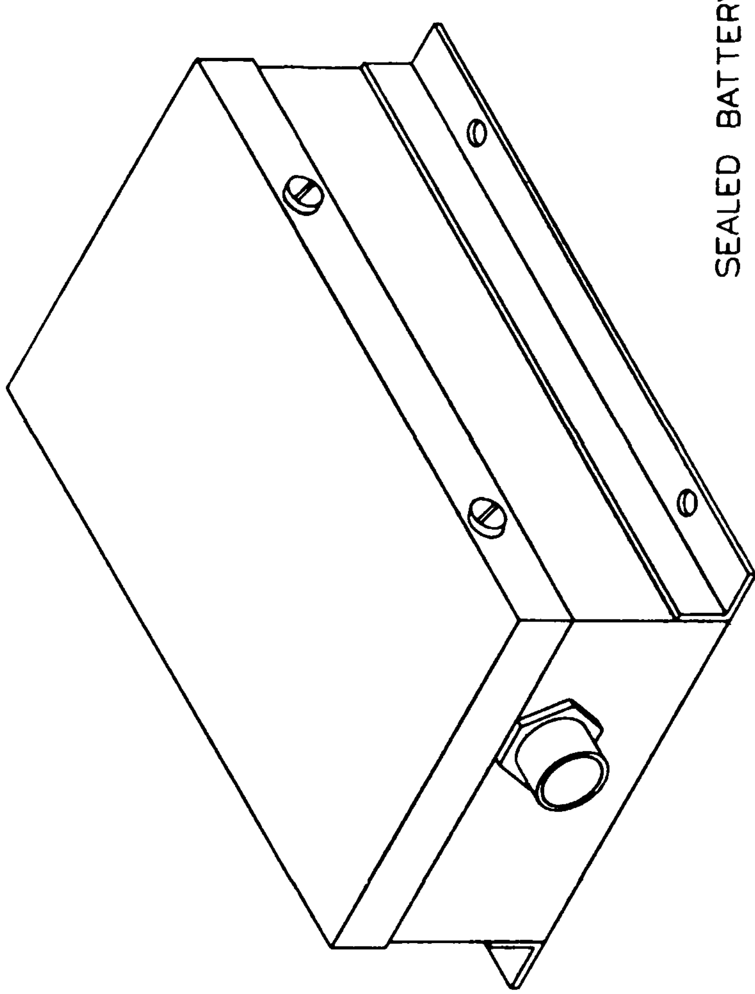
Physical characteristics of the four battery packages are as follows:

AH Rating	W	L	H	WT
1.2	4.75 in.	7.10 in.	2.24 in.	4.16 lb.
2.2	6.0 in.	9.25 in.	2.19 in.	6.75 lb.
4.0	6.0 in.	9.25 in.	3.05 in.	9.38 lb.
7.0	6.0 in.	9.25 in.	4.26 in.	13.75 lb.

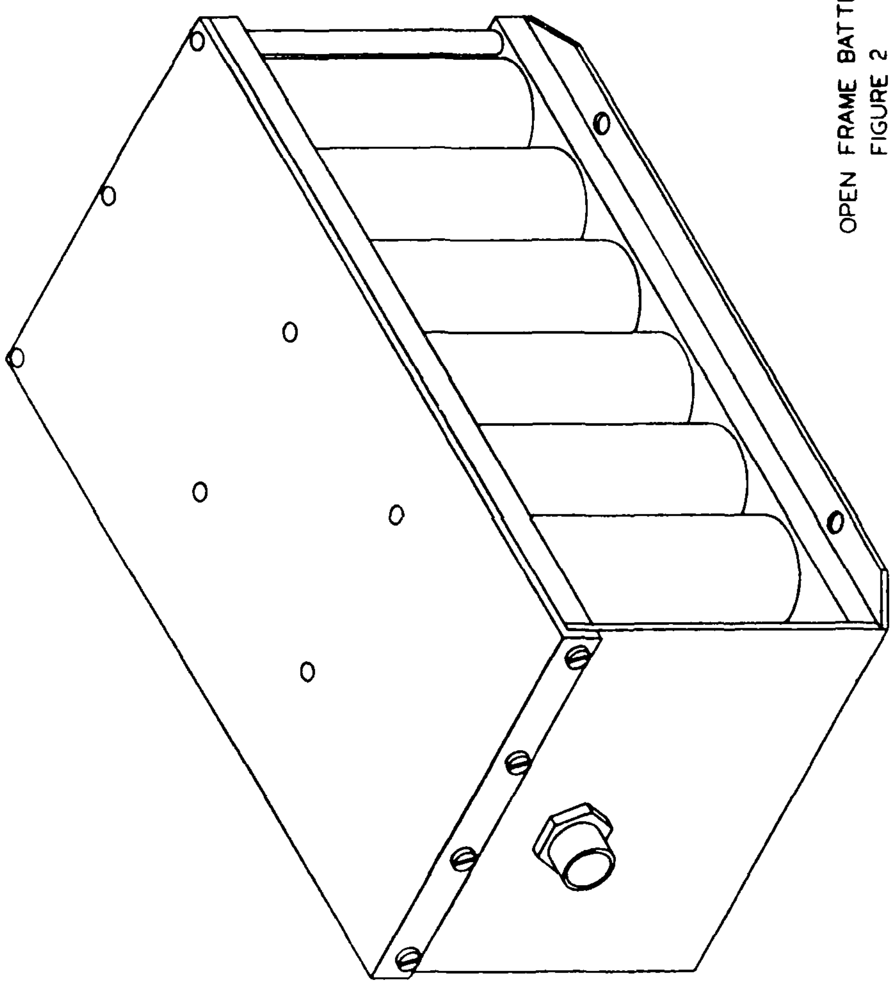
6. DOCUMENTATION

Tech Data Report #NU-183-3 "Battery Testing and Assembly Procedures" provides detailed fabrication information. The following drawings are also applicable.

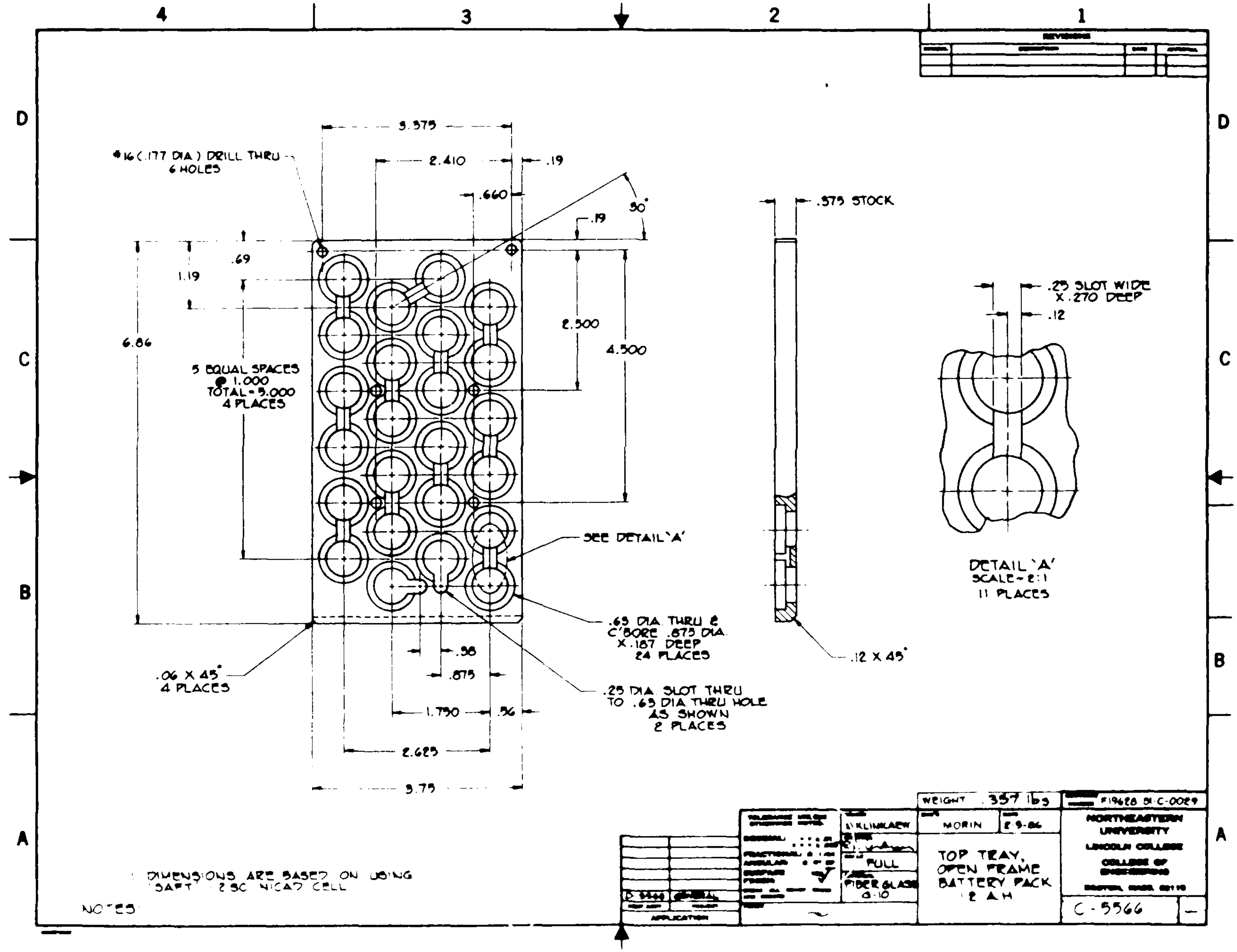
D-5061	Assembly, Open Frame Battery Pack
A-5056	Stand-Off, Open Frame Battery Pack
C-5057	Cover, Open Frame Battery Pack
C-5058	Bottom Tray, Open Frame Battery Pack
C-5059	Top Tray, Open Frame Battery Pack
D-5060	Base Mount, Open Frame Battery Pack
D-5061B	Assembly, Open Frame Battery Pack
D-5063	Wiring Sub-Assembly, Open Frame Battery Pack
D-5563	Base Mount, Open Frame Battery Pack (1.2AH)
C-5564	Cover, Open Frame Battery Pack (1.2AH)
C-5565	Bottom Tray, Open Frame Battery Pack (1.2AH)
C-5560	Top Tray, Open Frame Battery Pack (1.2AH)
D-5568	Assembly, Open Frame Battery Pack (1.2AH)



SEALED BATTERY BOX
FIGURE 1

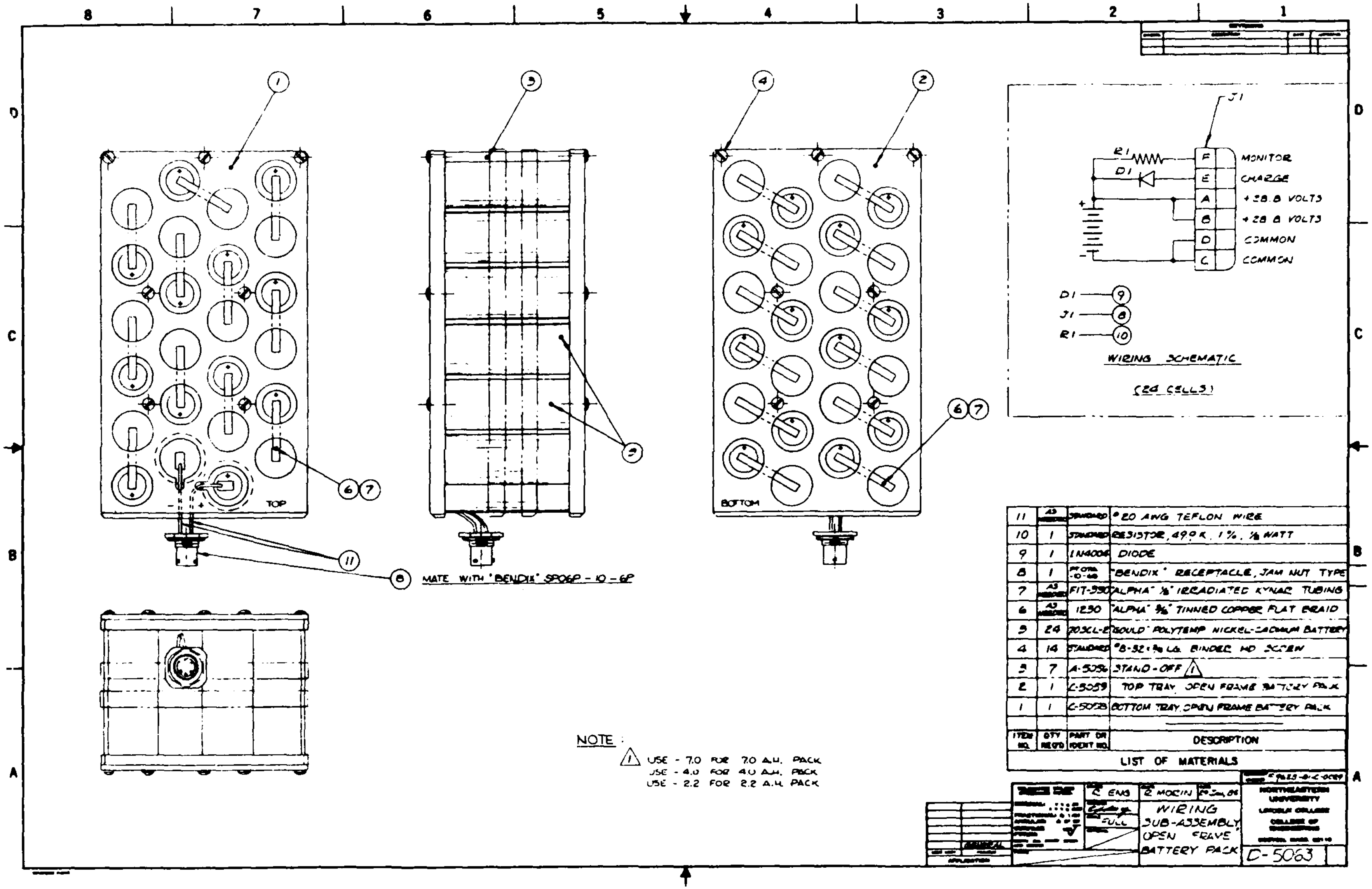


OPEN FRAME BATTERY
FIGURE 2



#16 (.177 DIA) DRILL THRU
6 HOLES
3.375
2.410
.19
.660
30°
.19
.375 STOCK
.69
1.19
6.86
2.500
4.500
5 EQUAL SPACES @ 1.000
TOTAL - 5.000
4 PLACES
.25 SLOT WIDE X .270 DEEP
.12
SEE DETAIL 'A'
DETAIL 'A'
SCALE ~ 2:1
11 PLACES
.65 DIA THRU & C'BORE .875 DIA X .187 DEEP
24 PLACES
.06 X 45°
4 PLACES
.38
.875
.12 X 45°
.25 DIA SLOT THRU TO .65 DIA THRU HOLE AS SHOWN
2 PLACES
1.750
.56
2.625
3.75
WEIGHT .357 lbs
F19628 81-C-0029
MORIN
2-9-86
NORTHEASTERN UNIVERSITY
LINCOLN COLLEGE
COLLEGE OF ENGINEERING
FULL
TOP TRAY, OPEN FRAME BATTERY PACK
12 AH
FIBER GLASS G-10
C-5566
APPLICATION
DIMENSIONS ARE BASED ON USING SAFT 2.5C NICAD CELL
NOTES

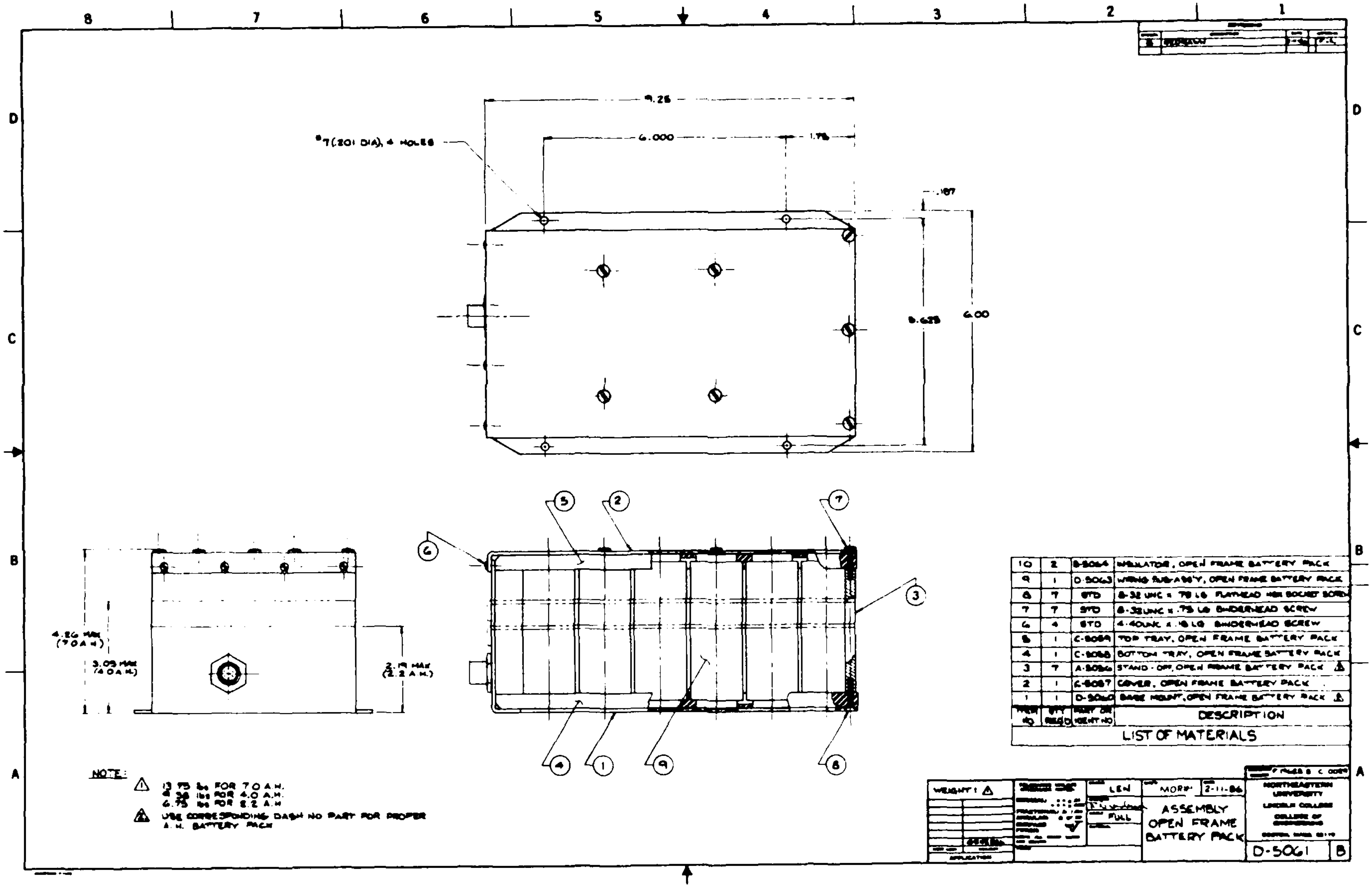
FIG. 3



ITEM NO.	QTY REQ'D	PART OR IDENT NO.	DESCRIPTION
11	AS REQ'D	STANDARD	#20 AWG TEFLON WIRE
10	1	STANDARD	RESISTOR, 49.9 K, 1%, 1/8 WATT
9	1	1N4006	DIODE
8	1	PT07A-10-6S	"BENDIX" RECEPTACLE, JAM NUT TYPE
7	AS REQ'D	FIT-350	"ALPHA" 1/8" IRRADIATED KYNAR TUBING
6	AS REQ'D	1230	"ALPHA" 3/16" TINNED COPPER FLAT BRAID
5	24	70SCL-E	"GOULD" POLYTEMP NICKEL-CADMIUM BATTERY
4	14	STANDARD	#8-32 x 3/8 LG. BINDER HD SCREW
3	7	A-5056	STAND-OFF ⚠1
2	1	C-5059	TOP TRAY OPEN FRAME BATTERY PACK
1	1	C-5058	BOTTOM TRAY OPEN FRAME BATTERY PACK

LIST OF MATERIALS

FIG. 4



9.25
6.000
1.75
.187
5.625
6.00
#7 (.201 DIA), 4 HOLES
4.26 MAX (7.0 A.H.)
3.05 MAX (4.0 A.H.)
2.19 MAX (2.2 A.H.)
NOTE:
1. 13.75 lbs FOR 7.0 A.H.
8.38 lbs FOR 4.0 A.H.
6.75 lbs FOR 2.2 A.H.
2. USE CORRESPONDING DASH NO PART FOR PROPER A.H. BATTERY PACK
10 | 2 | B-5064 | INSULATOR, OPEN FRAME BATTERY PACK
9 | 1 | D-5063 | WIRING SUB-ASS'Y, OPEN FRAME BATTERY PACK
8 | 7 | STD | 8-32 UNC x .75 LG FLATHEAD HEX SOCKET SCREW
7 | 7 | STD | 8-32 UNC x .75 LG SHOULDERHEAD SCREW
6 | 4 | STD | 4-40 UNC x .16 LG SHOULDERHEAD SCREW
5 | 1 | C-5059 | TOP TRAY, OPEN FRAME BATTERY PACK
4 | 1 | C-5058 | BOTTOM TRAY, OPEN FRAME BATTERY PACK
3 | 7 | A-5056 | STAND-OFF, OPEN FRAME BATTERY PACK
2 | 1 | C-5057 | COVER, OPEN FRAME BATTERY PACK
1 | 1 | D-5060 | BASE MOUNT, OPEN FRAME BATTERY PACK
DESCRIPTION
LIST OF MATERIALS
WEIGHT: 1
LEN
MORF
2-11-86
FULL
ASSEMBLY OPEN FRAME BATTERY PACK
NORTHEASTERN UNIVERSITY
LINCOLN COLLEGE
D-5061
B

FIG. 5

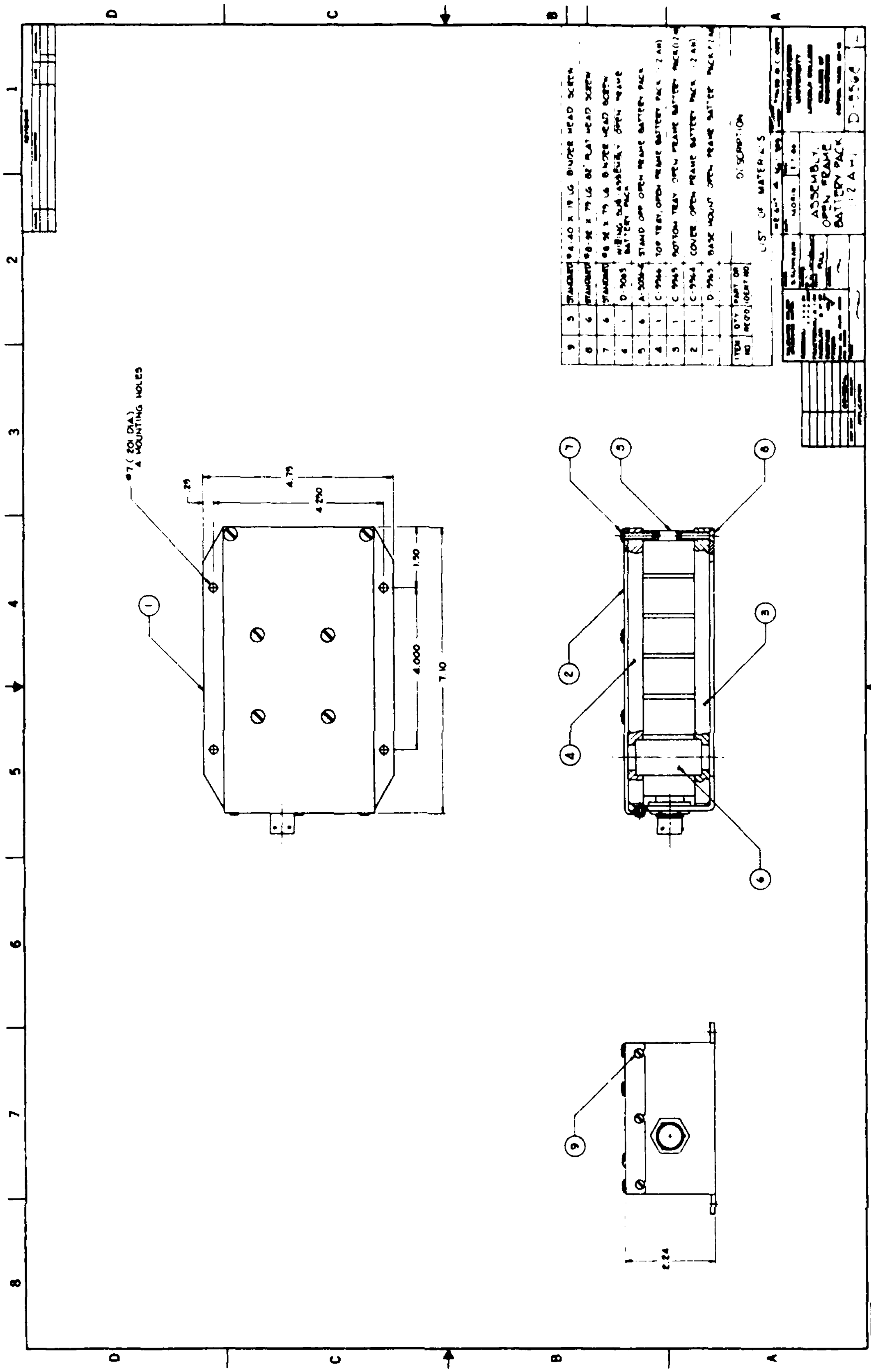

4 MOUNTING HOLES
4.79
4.290
1.90
4.000
7.10
2.24
DESCRIPTION
LIST OF MATERIALS
ASSEMBLY OPEN FRAME BATTERY PACK

FIG. 6

APPENDIX A

Related Contracts and Report

Contract No. AF19628-81-C-0029   15 Feb. 1981 to present.

R.L. Morin and C.B. Sweeney, "Model 2480 Timer", Scientific Report No. 1, AFGL-TR-85-0112, November 1982. ADA165281.

R.D. Anderson and R.C. Eng, "Manacle Band Release Mechanism", Scientific Report No. 2, AFGL-TR-85-0116, May 1985.

APPENDIX B

Personnel

The following members of the Electronics Research Laboratory staff contributed to the work reported.

Lawrence J. O'Connor	Principal Investigator
Richard L. Morin	Research Associate, Engineer
Robert D. Anderson	Mechanical Designer
Roger C. Eng	Mechanical Designer
Frederick J. Tracy	Electronic Technician
Harry M. Tweed, Jr.	Electronic Technician

END

DTIC

8-86